

International Gravity Field Service (IGFS)

https://doi.org/10.82507/iag-gh2024_igfs

Chair: Riccardo Barzaghi (Italy)
Central Bureau Director: Georges Vergos (Greece)

IGFS website - <http://igfs.topo.auth.gr/>



1 Introduction

IGFS is a unified “umbrella” IAG Service, coordinating the following “Level-1” IAG Services:

- BGI (Bureau Gravimétrique International), Toulouse, France
- ICGEM (International Center for Global Earth Models), GFZ, Potsdam, Germany
- ISG (International Service for the Geoid), Politecnico di Milano, Milano, Italy
- IGETS (International Geodynamics and Earth Tides Service), EOST, Strasbourg, France
- IDEMS (International Digital Elevation Model Service), ESRI, Redlands, CA, USA

Furthermore, IGFS has two Product Centers, the COST-G (Combination Service for Time-variable Gravity Fields) at AIUB, Berne, Switzerland and the IHRF-CC (International Height Reference Frame Coordination Center) at AUTH, Thessaloniki, Greece.

2 Mission, Objectives

The overall goal of IGFS is to:

- Coordinate collection, validation, archiving and dissemination of gravity field related data;
- Organize courses, generate information materials and in general organize public outreach relating to the Earth's gravity field;
- Unify gravity products for the needs of GGOS.

IGFS then facilitates the servicing of the geodetic and geophysical community with gravity field related data, software and information. The combined data of the IGFS entities will include global geopotential models, terrestrial, airborne, satellite and marine gravity observations, Earth tide data, GPS/leveling data, digital models of terrain and bathymetry, as well as ocean gravity field and geoid from satellite altimetry. Both the static and the temporal variations of the gravity field will be covered by the IGFS. Physical heights and potential values for the IHRF core sites, as well as offsets to national and regional heights systems will be also provided by IGFS. In cooperation with the other Gravity Services IGFS will make a special effort in trying to secure release of data from national and international institutions, holding data on the spatial and temporal gravity variations, geoid and the surface heights of the Earth, to make them widely available to the scientific community. IGFS will coordinate regional conferences, tutorials and schools to train young scientists and members of national institutions in the various aspects of the gravity field science, computations, and data collection.

3 Products

COST-G, as Product Center, provides consolidated monthly global gravity field models in terms of spherical harmonic coefficients and derived grids by combining solutions from individual Analysis Centers. These global gravity field models are available on the ICGEM web site.

IHRF-CC, as the Coordination Center for the IHRF will deliver the coordinates (X, Y, Z, C) (where $C(P) = W_0 - W(P)$ and $W_0 = 62636853.4 \text{ m}^2 \text{ s}^{-2}$ is the conventional selected value for the gravity potential at the geoid) of the IHRF reference stations and a catalogue of the vertical datum parameters, i.e., the transformation parameters between the existing local height systems and the IHRF.

The activities of COST-G and IHRF-CC will be annually reviewed by the IAG Executive Committee.

4 Program/Activities (2023-2027)

IGFS activities in the next four years term mainly focus on:

- improving the connection and cooperation among the Gravity Services.
- increasing the contacts with GGOS, particularly with the Bureau of Network and Observations and Bureau of Products and Standards.

- keeping contacts with the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) via the Global Geodetic Centre of Excellence (UN-GGCE).
- organizing, every two years, together with Commission 2 and GGOS, the Gravity Geoid and Height System (GGHS) Symposium: In 2024 it will take place in Thessaloniki, Greece, on September 4th-6th. Contacts have been also established to hold the next GGHS Symposium in India in 2026.
- organizing international schools on geoid computation and height systems: the last was in Buenos Aires and there are plans for holding the next in Kazakhstan.
- continuing and supporting the activities of the two IGFS Product Centers, namely COST-G and IHRF-CC.

5 Structure

The IGFS Service is organized by means of the following structure:

- Central Bureau
- Advisory Board
- Gravity Services
- IGFS Product Centers

Central Bureau

The Central Bureau acts as the central coordination and communication center of the IGFS. It provides i) a link between the IGFS entities, IAG, and external projects, networks or organizations (oceanic, atmospheric, hydrologic) and ii) a link to the GGOS Bureaus in order to communicate their requirements and recommendations to the IGFS Services. It will also implement standards and recommendations related to gravity field observations, secure consistency with geometric standards and promote their use within the geoscience community. Furthermore, the Central Bureau maintains the IGFS website and arranges gravity field related meetings and workshops.

Advisory Board

The IGFS Advisory Board is composed by the Chairs/Directors of the Gravity Services, the President of Commission 2, the President of GGOS and geodesists that are involved in scientific activities related to the gravity field:

- H. Abd-Elmotaal (Egypt)
- J.-P. Barriot (French Polynesia)
- S. Bonvalot (France); Chair BGI
- S. Bettadpur (USA); President IAG Commission 2
- M. Calvo (Spain); Chair IGETS
- R. Forsberg (Denmark)
- R. Goyal (India)
- T. Gruber (Germany)

- J. Huang (Canada)
- C. Hwang (Taiwan)
- E. S. Ince (Germany); Chair ICGEM
- A. Jäggi (Switzerland); Chair COST-G
- K. Kelly (USA); Chair IDEMS
- J. McCubbine (Australia)
- U. Marti (Switzerland); IAG Representative
- R. Pail (Germany)
- M. Reguzzoni (Italy); Chair ISG
- M. G. Sideris (Canada)
- L. Sánchez (Germany); GGOS President
- I. N. Tziavos (Greece)
- L. Vitushkin (Russia)
- G.S. Vergos (Greece); Chair IHRF-CC
- Y. Wang (USA)
- H. Wziontek (Germany)

Gravity Services

The Gravity Services are the “operating arms” of IGFS and are approved by the IAG Executive Committee. They are committed to produce services and products related to the gravity field of the Earth and/or the planets. Services and Centers can include bodies of structures external to the IAG (e.g., the BGI which is reporting to FAGS). They have their own governing bodies, nominated according to internal rules, also taking into account the interests of the supporting entities. In particular, each governing body has a Director, elected according to internal rules. Gravity Services maintain a list of data and products, providing them to the general public according to their policy of dissemination. They deliver services in the form of data archiving, data analysis and dissemination, software, training on gravity field estimation, support to field campaigns and so on.

IGFS Product Centers

- The COST-G (see <https://cost-g.org/>) will provide consolidated monthly global gravity field models in terms of spherical harmonic coefficients and derived grids by combining solutions from individual Analysis Centers. Terms of Reference can be found at <https://cost-g.org/consortium/>.
- The newly established IHRF-CC (<https://ihrfcc.topo.auth.gr/>) will manage the general coordination of activities for the IHRF and for the storage, publication, and servicing of the IHRF by implementing and updating a catalogue of the IHRF global reference stations. Terms of Reference can be found at http://igfs.topo.auth.gr/wp-content/uploads/2024/06/IHRF_CoordinationCenter_v5_Feb2024.pdf.

6 Point of Contact

IGFS-CB Department of Geodesy and Surveying, AUTH
Univ. Box 440, GR-54124, Thessaloniki (GREECE)
Email: igfs@topo.auth.gr
Web site: <https://igfs.topo.auth.gr/igfs-central-bureau/>
Telephone: +30 2310 994366
Fax: +30 2310 995948

Staff

Director: Georgios S. Vergos
Scientific Consultants: Ilias N. Tziavos, Chris Kotsakis, Dimitrios Tsoulis
Scientific Staff: Vassilios N. Grigoriadis
Scientific Staff & Secretary: Dimitrios A. Natsiopoulos

7 Publications, Meetings

Publications on the main activities can be found on the Gravity Services web pages:

- BGI - <https://bgi.obs-mip.fr/>
- ICGEM - <https://icgem.gfz-potsdam.de/home>
- ISG - <https://www.isgeoid.polimi.it/>
- IGETS - <http://igets.u-strasbg.fr/>
- IDEMS - <https://idems.maps.arcgis.com/home/index.html>

Either during the GGHS Symposium and/or during the IAG/IUGG Assembly, IGFS splinter meetings are usually planned.

Bibliography

- [1] van Camp, M. and dos Santos, F. P. and Murböck, M. and Petit, G. and Müller, J., *Eos, Transactions American Geophysical Union*. **102** (2021). DOI 10.1029/2021EO210673
- [2] GGOS, in *Global Geodetic Observing System*, ed. by H.P. Plag, M. Pearlman (Springer Berlin, Heidelberg, 2009). DOI 10.1007/978-3-642-02687-4
- [3] Willis, P. and Lemoine, F.G. and Moreaux, G. and Soudarin, L. and Ferrage, P. and Ries, J. and Otten, M. and Saunier, J. and Noll, C. and Biancale, R. and Luzum, B., *IAG Symposia Series* **143**, 631 (2016). DOI 10.1007/1345_2015_164
- [4] Johnston, G. and Riddell, A. and Hausler, G., in *Springer Handbook of Global Navigation Satellite Systems*, ed. by P.J.G. Teunissen, O. Montenbruck (Springer International Publishing, Cham, 2017), pp. 967–982. DOI 10.1007/978-3-319-42928-1
- [5] Nothnagel, A. and Arzt, T. and Behrend, D. and Malkin, Z., *Journal of Geodesy* **91**(7), 711–721 (2017). DOI 10.1007/s00190-016-0950-5
- [6] S. Bonvalot, A. Briais, M. Kuhn, A. Peyrefitte, N. Vales, R. Biancale, G. Gabalda, G. Moreaux, F. Reinquin, M. Sarrailh, *International Gravimetric Bureau* (2012). DOI 10.18168/BGI.23. URL <https://bgi.obs-mip.fr/catalogue?uuid=df2dab2d-a826-4776-b49f-61e8b284c409>. 10.18168/BGI.23
- [7] G. Gabalda, S. Bonvalot. Mgl_quickview : Micro-g lacoste fg5/a10 results quick view (2023). DOI 10.18168/BGI.22. URL <https://bgi.obs-mip.fr/catalogue?uuid=7cfb9b19-987f-4532-a042-d6c0df9cb7f6>. 10.18168/BGI.22
- [8] G. Gabalda, S. Bonvalot. Cg6tool : Scintrex gravity data processing (2024). DOI 10.18168/BGI.21. URL <https://bgi.obs-mip.fr/catalogue?uuid=5c7699c7-c428-426e-b0a9-42764fc2998a>. 10.18168/BGI.21
- [9] H. Wziontek, S. Bonvalot, R. Falk, G. Gabalda, J. Mäkinen, V. Pálincás, A. Rülke, L. Vitushkin, *Journal of Geodesy* **95**(1), 7 (2021). DOI 10.1007/s00190-020-01438-9. URL <http://link.springer.com/10.1007/s00190-020-01438-9>
- [10] H. Wilmes, L. Vitushkin, V. Pálincás, R. Falk, H. Wziontek, S. Bonvalot, in *International Symposium on Earth and Environmental Sciences for Future Generations*, vol. 147, ed. by J.T. Freymueller, L. Sánchez (Springer International Publishing, Cham, 2016), pp. 25–29. DOI 10.1007/1345_2016_245. URL http://link.springer.com/10.1007/1345_2016_245. Series Title: International Association of Geodesy Symposia
- [11] Y. Bidet, N. Zahzam, A. Bresson, C. Blanchard, A. Bonnin, J. Bernard, M. Cadoret, T.E. Jensen, R. Forsberg, C. Salaun, S. Lucas, M.F. Lequentrec-Lalancette, D. Rouxel, G. Gabalda, L. Seoane, D.T. Vu, S. Bruinsma, S. Bonvalot, *Journal of Geophysical Research: Solid Earth* **128**(4), e2022JB025921 (2023). DOI 10.1029/2022JB025921. URL <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2022JB025921>
- [12] D.T. Vu, S. Bonvalot, L. Seoane, G. Gabalda, D. Remy, S. Bruinsma, Y. Bidet, A. Bresson, N. Zahzam, D. Rouxel, C. Salaün, M.F. Lalancette, R. Forsberg,

- T. Jensen, O. Jamet, *Journal of Geodesy* **98**(4), 28 (2024). DOI 10.1007/s00190-024-01839-0. URL <https://link.springer.com/10.1007/s00190-024-01839-0>
- [13] P. Zahorec, J. Papčo, R. Pašteka, M. Bielik, S. Bonvalot, C. Braitenberg, J. Ebbing, G. Gabriel, A. Gosar, A. Grand, H.J. Götze, G. Hetényi, N. Holzrichter, E. Kissling, U. Marti, B. Meurers, J. Mrlina, E. Nogová, A. Pastorutti, C. Salaun, M. Scarponi, J. Sebera, L. Seoane, P. Skiba, E. Szűcs, M. Varga, *Earth System Science Data* **13**(5), 2165 (2021). DOI 10.5194/essd-13-2165-2021. URL <https://essd.copernicus.org/articles/13/2165/2021/>
- [14] D.T. Vu, S. Bruinsma, S. Bonvalot, *Earth, Planets and Space* **71**(1), 65 (2019). DOI 10.1186/s40623-019-1045-3. URL <https://earth-planets-space.springeropen.com/articles/10.1186/s40623-019-1045-3>
- [15] D.T. Vu, S. Bruinsma, S. Bonvalot, D. Remy, G.S. Vergos, *Remote Sensing* **12**(5), 817 (2020). DOI 10.3390/rs12050817. URL <https://www.mdpi.com/2072-4292/12/5/817>
- [16] D.T. Vu, S. Bonvalot, S. Bruinsma, L.K. Bui, *Earth, Planets and Space* **73**(1), 92 (2021). DOI 10.1186/s40623-021-01415-2. URL <https://earth-planets-space.springeropen.com/articles/10.1186/s40623-021-01415-2>
- [17] Reguzzoni, M. and Carrion, D. and De Gaetani, C. I. and Albertella, A. and Rossi, L. and Sona, G. and Batsukh, K. and Toro Herrera, J. F. and Elger, K. and Barzaghi, R. and Sansó, F., *Earth Syst. Sci. Data* **13**, 1653 (2021). DOI 10.5194/essd-13-1653-2021